In This Section

- Sources and Types of Environmental Stressors
- Summary of Stressors Affecting Water Quality

Section 4

Water Quality: Environmental Stressors

Sections 4, 5, 6, and 7 are closely linked, providing the foundation for the water quality concerns in the basin, identifying the priority issues based on these concerns, and finally, recommending management strategies to address these concerns. Therefore, the reader will probably want to flip back and forth between sections to track specific issues.

This section describes the important environmental stressors that impair or threaten water quality in the Ocmulgee River basin. Section 4.1 first discusses the major sources of environmental stressors. Section 4.2 then provides a summary of individual stressor types as they relate to all sources. These include both traditional chemical stressors, such as metals or oxygen demanding waste, and less traditional stressors, such as modification of the flow regime (hydromodification) and alteration of physical habitat.

4.1 Sources and Types of Environmental Stressors

Environmental stressors are first catalogued by type of source in this section. This is the traditional programmatic approach, and it provides a match to regulatory lines of authority for permitting and management. Assessment requires an integration of stressor loads across all sources, as described in Section 4.2.

4.1.1 Point Sources and Non-discharging Waste Disposal Facilities

Point sources are defined as discharges of treated wastewater to the river and its tributaries, regulated under the National Pollutant Discharge Elimination System (NPDES). These are divided into two main types: permitted wastewater discharges, which tend to be discharged at relatively stable rates; and permitted stormwater discharges, which tend to be discharged at highly irregular, intermittent rates, depending on precipitation. Nondischarging waste disposal facilities, including land application systems and landfills, which are not intended to discharge treated effluent to surface waters, are also discussed in this section.

NPDES Permitted Wastewater Discharges

The EPD NPDES permit program regulates municipal and industrial waste discharges, monitors compliance with limitations, and takes appropriate enforcement action for violations. For point source discharges, the permit establishes specific effluent limitations and specifies compliance schedules that must be met by the discharger. Effluent limitations are designed to achieve water quality standards in the receiving water and are reevaluated periodically (at least every five years).

Municipal Wastewater Discharges

Municipal wastewater treatment plants are among the most significant point sources regulated under the NPDES program in the Ocmulgee River basin, accounting for the majority of the total point source effluent flow (exclusive of cooling water). These plants collect, treat, and release large volumes of treated wastewater. Pollutants associated with treated wastewater include pathogens, nutrients, oxygen-demanding waste, metals, and chlorine residuals. Over the past several decades, Georgia has invested more than $100 million in construction and upgrade of municipal water pollution control plants in the Ocmulgee River basin. These upgrades have resulted in significant reductions in pollutant loading and consequent improvements in water quality below wastewater treatment plant outfalls. As of the 1999-2001 water quality assessment, 17 miles of rivers/streams were identified in which municipal discharges contributed to not fully supporting designated uses, all of which are being addressed through the NPDES permitting process.

Table 4-1 displays the major municipal wastewater treatment plants with permitted discharges of one million gallons per day (MGD) or greater in the Ocmulgee River basin. The geographic distribution of dischargers is shown in Figure 4-1. In addition, there are discharges from a variety of smaller wastewater treatment plants, including both public facilities (small public water pollution control plants, schools, marinas, etc.) and private facilities (package plants associated with non-sewered developments and mobile home parks) with less than a 1 MGD flow. These minor discharges might have the potential to cause localized stream impacts, but they are relatively insignificant from a basin perspective. A complete list of permitted dischargers in the Ocmulgee River basin in presented in Appendix C.

Table 4-1. Major Municipal Wastewater Treatment Plant Discharges with Permitted Monthly Flow Greater than 1 MGD in the Ocmulgee River Basin

NPDES Permit No.	Facility Name	County	Receiving Stream	Permitted Monthly Avg. Flow
		HUC 03070103		
GA0021041	BARNESVILLE GORDON RD	LAMAR	TOBESOFKEE CR	1.2
GA0038423	CASEY & HUIE WRF	CLAYTON	BLALOCK RESERVOIR	15
GA0020575	CLAYTON CO NORTHEAST	CLAYTON	PANTHER CR	6
GA0026816	DEKALB CO POLEBRIDGE CR	DEKALB	SOUTH RV	20
GA0024147	DEKALB CO SNAPFINGER CR	DEKALB	SOUTH RV	36
GA0031801	FORSYTH NORTHEAST	MONROE	TOWN CR TO RUM CR	1.4
GA0020214	GRIFFIN CABIN CREEK	SPALDING	CABIN CREEK	1.5
GA0032841	GWINNETT CO BEAVER/SWEETWATER	GWINNETT	SWEETWATER	4.5
GA0047627	GWINNETT CO JACKS CR	GWINNETT	YELLOW RV TO OCMULGEE RV	1
GA0030732	GWINNETT CO JACKSON CR	GWINNETT	JACKSON CR	3
GA0023973	GWINNETT CO NO BUSINESS	GWINNETT	NO BUSINESS CR	1
GA0047911	GWINNETT CO YELLOW RV	GWINNETT	YELLOW RV/SWEETWATER CR	12
GA0049352	HENRY CO CAMP CR	HENRY	CAMP CREEK TRIB	1.5
GA0020788	LOGANVILLE WPCP	WALTON	BIG FLAT CR TRIB	1.75
GA0024538	MACON POPLAR ST	BIBB	OCMULGEE RV	20
GA0024546	MACON ROCKY CR	BIBB	OCMULGEE RV	24
GA0023949	MCDONOUGH WALNUT CR	HENRY	WALNUT CR	1
GA0021610	ROCKDALE CO ALMAND BRANCH	ROCKDALE	ALMAND BR TO SOUTH RV	1.25
GA0047678	ROCKDALE CO QUIGG BRANCH	ROCKDALE	YELLOW RV	3
		HUC 03070104		
GA0031046	FORT VALLEY WPCP	PEACH	BAY CR TO INDIAN CR TRIB	2.2
GA0020338	HAWINSVILLE SOUTH	PULASKI	OCMULGEE RV	1.3
GA0046027	HAWKINSVILLE NORTH	PULASKI	OCMULGEE RV	1
GA0036765	HAZLEHURST BULLY CR	JEFF DAVIS	OCMULGEE RV	1.5
GA0021334	PERRY WPCP	HOUSTON	BIG INDIAN CREEK	3
GA0037796	WARNER ROBINS OCMULGEE RV	HOUSTON	OCMULGEE RV	3
GA0030325	WARNER ROBINS SANDY RUN	HOUSTON	SANDY RUN CR	9

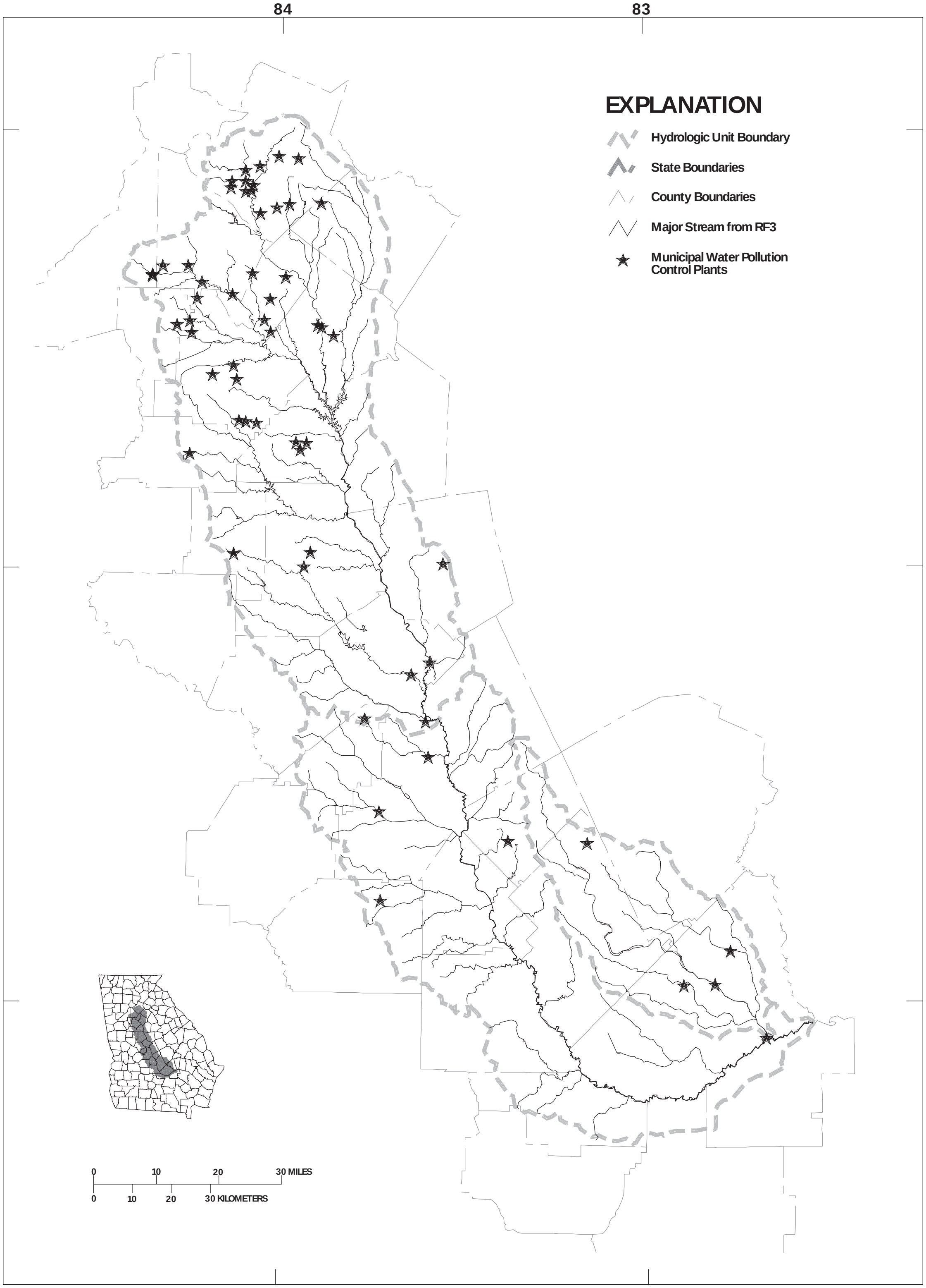

Figure 4-1. Geographic Distribution of Dischargers

Most urban wastewater treatment plants also receive industrial process and nonprocess wastewater, which can contain a variety of conventional and toxic pollutants. The control of industrial pollutants in municipal wastewater is addressed through pretreatment programs. The major publicly owned wastewater treatment plants in this basin have developed and implemented approved local industrial pretreatment programs. Through these programs, the wastewater treatment plants are required to establish effluent limitations for their significant industrial dischargers (those which discharge in excess of 25,000 gallons per day of process wastewater or are regulated by a Federal Categorical Standard) and to monitor the industrial user's compliance with those limits. The treatment plants are able to control the discharge of organics and metals into their sewerage system through the controls placed on their industrial users.

Industrial Wastewater Discharges

Industrial and federal wastewater discharges are also significant point sources regulated under the NPDES program. There are a total of 111 permitted municipal, state, federal, private, and industrial wastewater and process water discharges in the Ocmulgee River basin, as summarized in Table 4-2 and shown in Figures 4-2 through 4-4. The complete permit list is summarized in Appendix C.

Table 4-2. Summary of NPDES Permits in the Ocmulgee River Basin

HUC	Major Municipal Facilities	Major Industrial and Federal Facilities	Minor Public Facilities	Minor Private and Industrial Facilities	Total
03070103	19	3	25	37	84
03070104	7	1	4	5	17
03070105	0	0	8	2	10
Total	*26*	*4*	*37*	*44*	*111*

The nature of industrial discharges varies widely compared to discharges from municipal plants. Effluent flow is not usually a good measure of the significance of an industrial discharge. Industrial discharges can consist of organic, heavy oxygen-demanding waste loads from facilities such as pulp and paper mills; large quantities of non-contact cooling water from facilities such as power plants; pit pumpout and surface runoff from mining and quarrying operations, where the principal source of pollutants is the land-disturbing activity rather than the addition of any chemicals or organic material; or complex mixtures of organic and inorganic pollutants from chemical manufacturing, textile processing, metal finishing, etc. Pathogens and chlorine residuals are rarely of concern with industrial discharges, but other conventional and toxic pollutants must be addressed on a case-by-case basis through the NPDES permitting process. Table 4-3 lists the major industrial and federal wastewater treatment plants with discharges into the Ocmulgee River basin in Georgia.

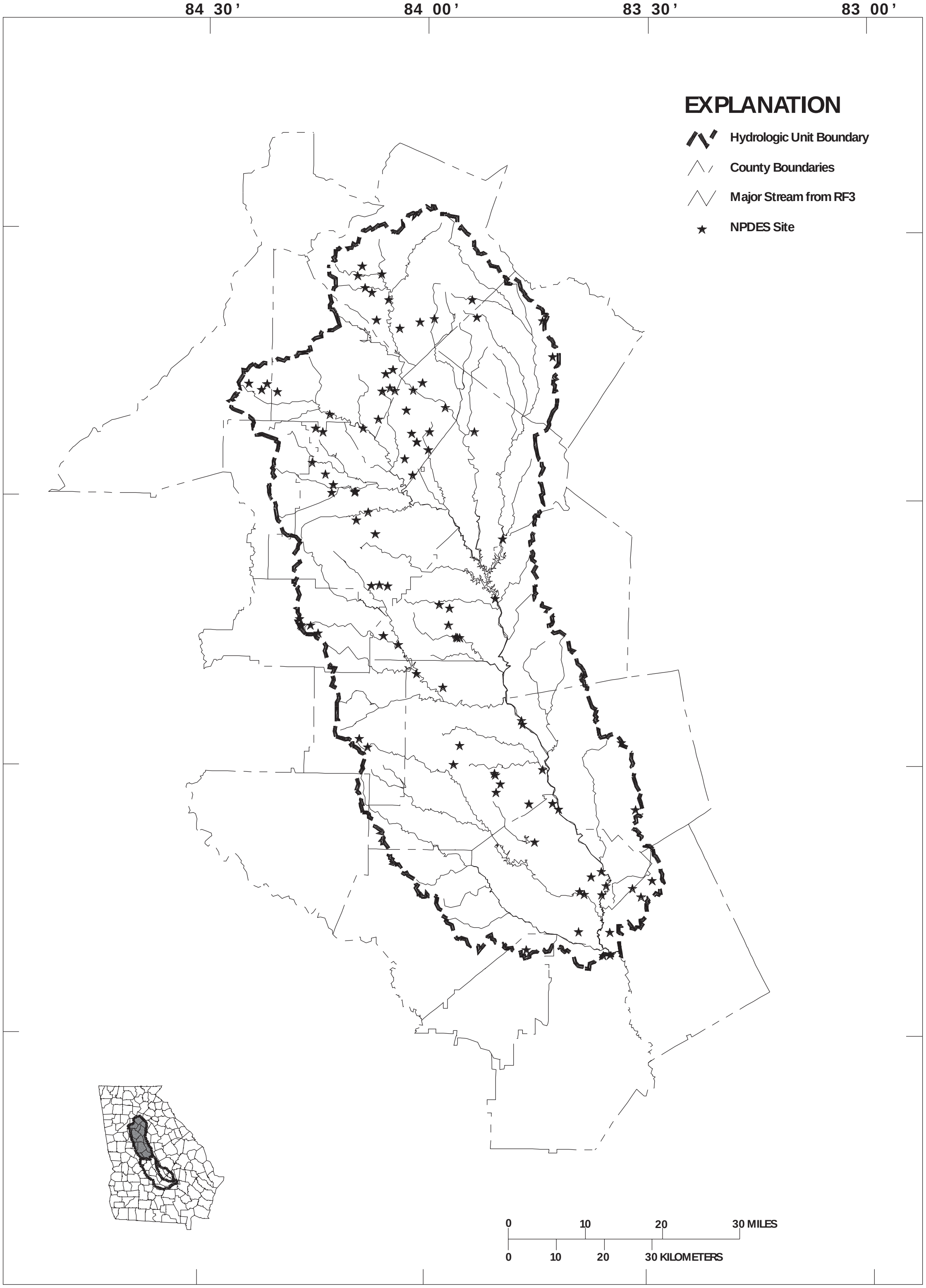

Figure 4-2. Locations of Permitted Point Source Discharges, Ocmulgee River Basin, HUC 03070103

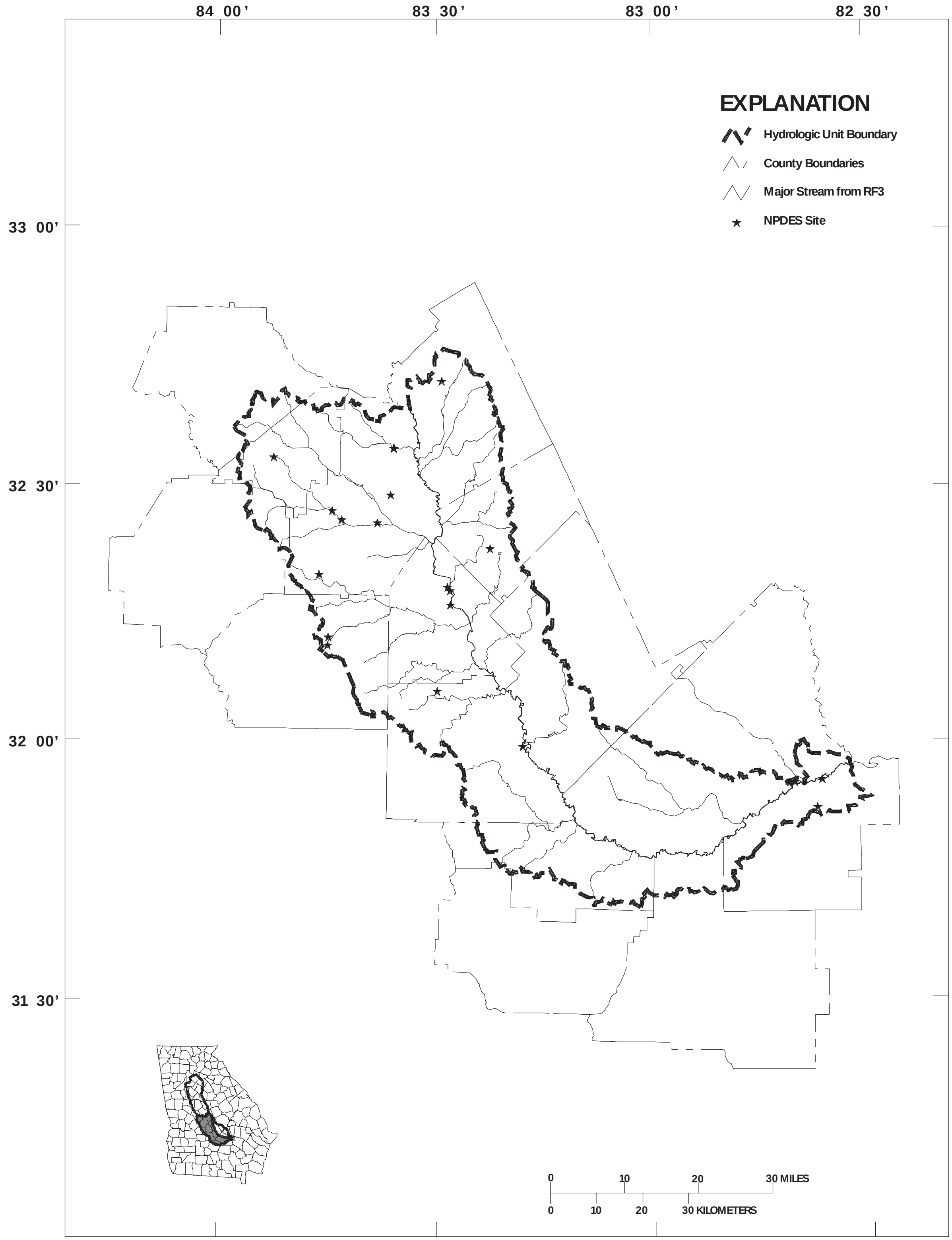

Figure 4-3. Locations of Permitted Point Source Discharges, Ocmulgee River Basin, HUC 03070104

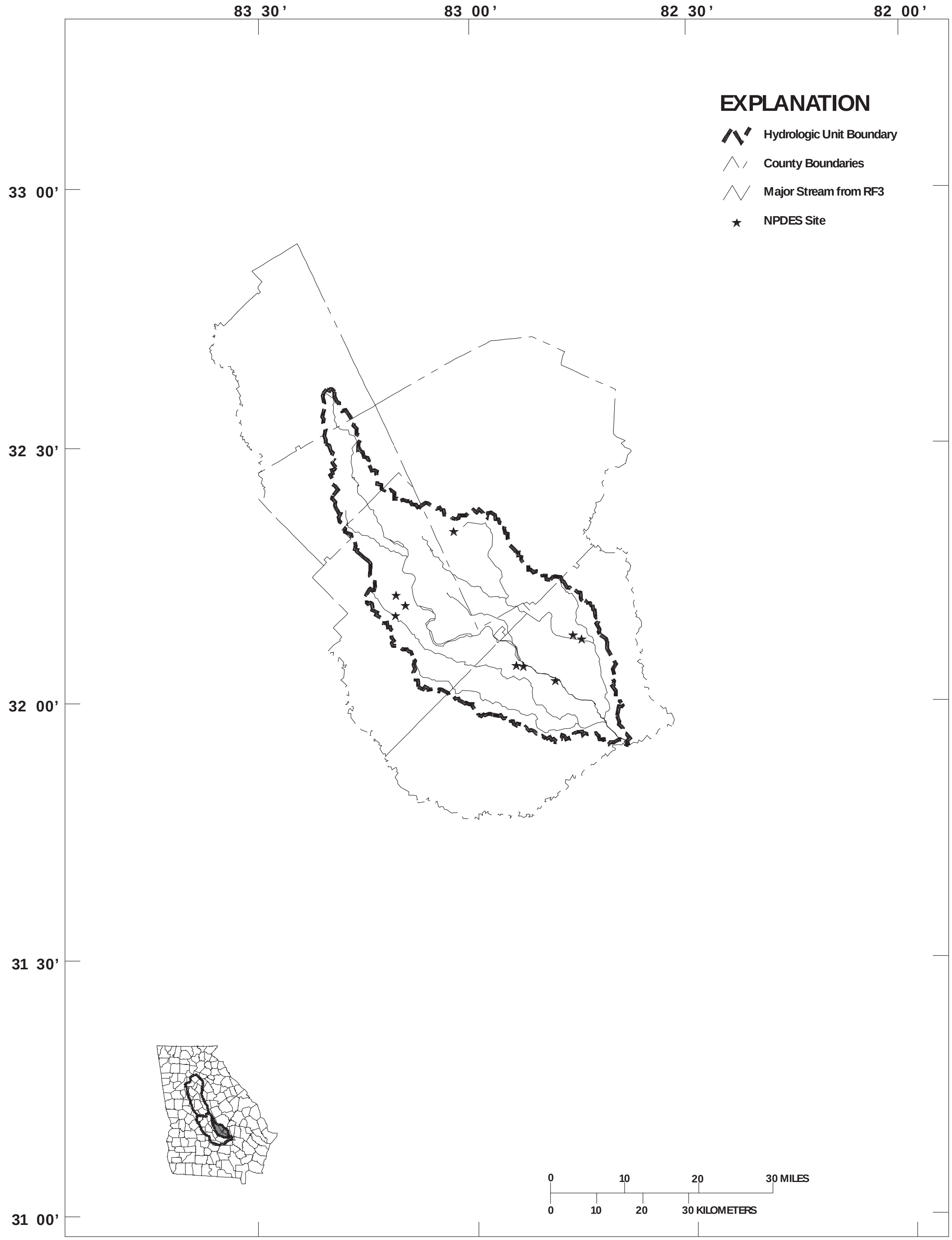

Figure 4-4. Locations of Permitted Point Source Discharges, Ocmulgee River Basin, HUC 03070105

Table 4-3. Major Industrial and Federal Wastewater Treatment Facilities in the Ocmulgee River Basin

NPDES Permit No.	Facility Name	County	Description	Flow (Mgd)	Receiving Stream
HUC 03070103					
GA0026069	GA POWER ARKWRIGHT	BIBB	INDUSTRY	480	OCMULGEE RV
GA0003409	SPRINGS IND INC GRIFFIN	SPALDING	INDUSTRY	1	CABIN CR
GA0003115	WILLIAM CARTER COMPANY	LAMAR	INDUSTRY	1.3	TOBESOFKEE CR
HUC 03070104					
GA0002852	USAF ROBINS AFB	HOUSTON	FEDERAL	2.1	HORSE CR TRIB

There are also minor industrial discharges that may have the potential to cause localized stream impacts, but are relatively insignificant from a basin perspective.

Combined Sewer Overflows

Combined sewers carry both stormwater runoff and sanitary sewage in the same pipe. Most combined sewers were built at the turn of the century and were present in most large cities. At that time, both sewage and stormwater runoff were piped from the buildings and streets to the small streams that originated in the heart of the city. When these streams were enclosed in pipes, they became today's combined sewer systems. As the cities grew, their combined sewer systems expanded. Often new combined sewers were laid to move the untreated wastewater discharge to the outskirts of the town or to the nearest water body.

In later years, wastewater treatment facilities were built and smaller sanitary sewers were constructed to carry the sewage (dry weather flows) from the termination of the combined sewers to these facilities for treatment. However, during wet weather when significant stormwater is carried in the combined system, the sanitary sewer capacity is exceeded and a combined sewer overflow (CSO) occurs. The surface discharge is a mixture of stormwater and sanitary waste. Uncontrolled CSOs thus discharge raw diluted sewage and can introduce elevated concentrations of bacteria, oxygen-demanding waste (BOD), and solids into a receiving water body. In some cases, CSOs discharge into relatively small creeks.

CSOs are considered a point source of pollution and are subject to the requirements of the Clean Water Act. Although CSOs are not required to meet secondary treatment effluent limits, sufficient controls are required to protect water quality standards for the designated use of the receiving stream. In its 1990 session, the Georgia Legislature passed a CSO law requiring all Georgia cities to eliminate or treat CSOs.

There is one City of Atlanta CSO that is treated prior to discharge to a tributary of the South River in the upper Ocmulgee River basin (HUC 03070103).

NPDES Permitted Stormwater Discharges

Urban stormwater runoff in the Ocmulgee basin has been identified as a source of stressors from pollutants such as BOD and fecal coliform bacteria. Stormwater may flow directly to streams as a diffuse, nonpoint process, or may be collected and discharged through a storm sewer system. Some storm sewer systems are now subject to NPDES permitting and are discussed in this section. Contributions from nonpoint stormwater are discussed in later sections.

Pollutants typically found in urban stormwater runoff include pathogens (such as bacteria and viruses from human and animal waste), heavy metals, debris, oil and grease, petroleum hydrocarbons, and a variety of compounds toxic to aquatic life. In addition, the runoff often contains sediment, excess organic material, fertilizers (particularly nitrogen and phosphorus compounds), herbicides, and pesticides which can upset the natural balance of aquatic life in lakes and streams. Stormwater runoff may also increase the temperature of a receiving stream during warm weather, which may threaten fisheries in the Ocmulgee River basin. All of these pollutants, and many others, influence the quality of stormwater runoff. There are also many potential problems related to the quantity of urban runoff, which can contribute to flooding and erosion in the immediate drainage area and downstream.

Municipal Stormwater Discharges

In accordance with Federal Phase I stormwater regulations, the State of Georgia has issued individual area-wide NPDES municipal separate storm sewer system (MS4) permits to 58 cities and counties in municipal areas with populations greater than 100,000 persons. A total of 25 Phase I municipalities drain to the Ocmulgee River basin. Of the 86 cities and counties affected by the Phase II stormwater regulations, 21 are in the Ocmulgee River basin.

Industrial Stormwater Discharges

Industrial sites often have their own stormwater conveyance systems. The volume and quality of stormwater discharges associated with industrial activity is dependent on a number of factors, such as the industrial activities occurring at the facility, the nature of the precipitation, and the degree of surface imperviousness (hard surfaces). These discharges are of intermittent duration with short-term pollutant loadings that can be high enough to have shock loading effects on the receiving waters. The types of pollutants from industrial facilities are generally similar to those found in stormwater discharges from commercial and residential sites; however, industrial facilities have a significant potential for discharging at higher pollutant concentrations, and may include specific types of pollutants associated with a given industrial activity.

EPD has issued one general permit regulating stormwater discharges for 10 of 11 federally regulated industrial subcategories. The general permit for industrial activities requires the submission of a Notice of Intent (NOI) for coverage under the general permit; the preparation and implementation of stormwater pollution prevention plan; and, in some cases, analytical testing of stormwater discharges from the facility. As with the municipal stormwater permits, implementation of site-specific best management practices is the preferred method for controlling stormwater runoff. As of May 2003, approximately 594 NOIs had been filed for the Ocmulgee River basin.

The 11th federally regulated industrial subcategory (construction activities) is covered under NPDES General Permit No. GAR100000. This general permit regulates stormwater discharges associated with construction activity at sites and common developments disturbing more than five acres. The general permit requires the submission of an NOI to obtain coverage under the permit, the preparation and implementation of an Erosion, Sedimentation, and Pollution Control Plan, and the preparation and implementation of a Comprehensive Monitoring Program, which provides for monitoring of turbidity levels in the receiving stream(s) and/or stormwater outfalls(s) during certain rain events. The general permit became effective on August 1, 2000, and will be renewed in 2003 to include construction sites between one and five acres.

Nondischarging Waste Disposal Facilities

Land Application Systems (LASs)

In addition to permits for point source discharges, EPD has developed and implemented a permit system for land application systems (LASs). LASs for final disposal of treated wastewaters have been encouraged in Georgia and are designed to eliminate surface discharges of effluent to waterbodies. LASs are used as an alternative to advanced levels of treatment or as the only alternative in some environmentally sensitive areas.

When properly operated, an LAS should not be a source of stressors to surface waters. The locations of LASs are, however, worth noting because of the (small) possibility that a LAS could malfunction and become a source of stressor loading. Also, it is possible that contaminants, such as nutrients, could be transported offsite via groundwater and this potential source should be considered in watershed assessments where nutrient sensitive waters are located downstream.

A total of 171 municipal and 54 industrial permits for land application systems were in effect in Georgia in 2003. Municipal and other wastewater land application systems within the Ocmulgee Basin are listed in Table 4-4. The locations of all LASs within the basin are shown in Figures 4-5 through 4-7.

Landfills

Permitted landfills are required to contain and treat any leachate or contaminated runoff prior to discharge to any surface water. The permitting process encourages either direct connection to a publicly owned treatment works (although vehicular transportation is allowed in certain cases) or treatment and recirculation on site to achieve a no-discharge system. Direct discharge in compliance with NPDES requirements is allowed but is not currently practiced by any landfills in Georgia. Groundwater contaminated by landfill leachate from older, unlined landfills represents a potential threat to waters of the state. Groundwater and surface water monitoring and corrective action requirements are in place for all landfills operated after 1988 to identify and rededicate potential threats. The provisions of the Hazardous Sites Response Act address threats posed by older landfills as releases of hazardous constituents are identified. All new municipal solid waste landfills are required to be lined and to have a leachate collection system installed.

EPD’s Land Protection Branch is responsible for permitting and compliance of municipal and industrial Subtitle D landfills. The location of permitted landfills within the basin is shown in Figure 4-8 through 4-10.

Table 4-4. Wastewater Land Application Systems in the Ocmulgee River Basin

Facility Name	County	Permit No.	Permitted Flow (MGD)
AMERICAN DEHYDRATED FOODS	WALTON	GA01-571	
ATLANTA SOUTH KOA	HENRY	GA03-829	0.02
BUTTS CO WATER & SEWER LAS	BUTTS	GA02-038	0.3
CA SIMPSON COMMERICIAL PROPERTY	BUTTS	GA02-225	0.3
CHESTER	DODGE	GA02-202	0.175
CHRIST SANCTIFIED HOLY CHURCH	HOUSTON	GA03-962	0.018
CLAYTON CO HUIE LAS	CLAYTON	GA02-008	19.5
COVINGTON	NEWTON	GA02-055	4.8
FLYING J INC	BUTTS	GA03-799	0.06
GA DIAGNOSTIC CENTER	BUTTS	GA02-245	0.225
GA PUBLIC SAFETY TRAINING CENTER	MONROE	GA02-201	0.12
HENRY CO INDIAN CR LAS	HENRY	GA02-250	1.5
HENRY CO SIMPSON MILL LAS	HENRY	GA02-203	0.18
HENRY CO SPRINGDALE LAS	HENRY	GA02-239	1
HY-LINE INTERNATIONAL INC	NEWTON	GA01-461	0.002
LOCUST GROVE LAS	HENRY	GA02-070	0.3
LOGANVILLE LAS	WALTON	GA02-174	0.25
MCRAE LAD	TELFAIR	GA02-248	0.8
MELROSE SUBDIVISION	HENRY	GA03-832	
MILAN	DODGE	GA02-086	0.2
PUBLIX SUPER MARKET	GWINNETT	GA02-220	
UNADILLA	DOOLY	GA02-151	0.54
UNITY GROVE ELEMENTARY	HENRY	GA03-835	0.013
WALNUT CREEK RECLAMAMTION FACILITY	HENRY	GA02-137	4

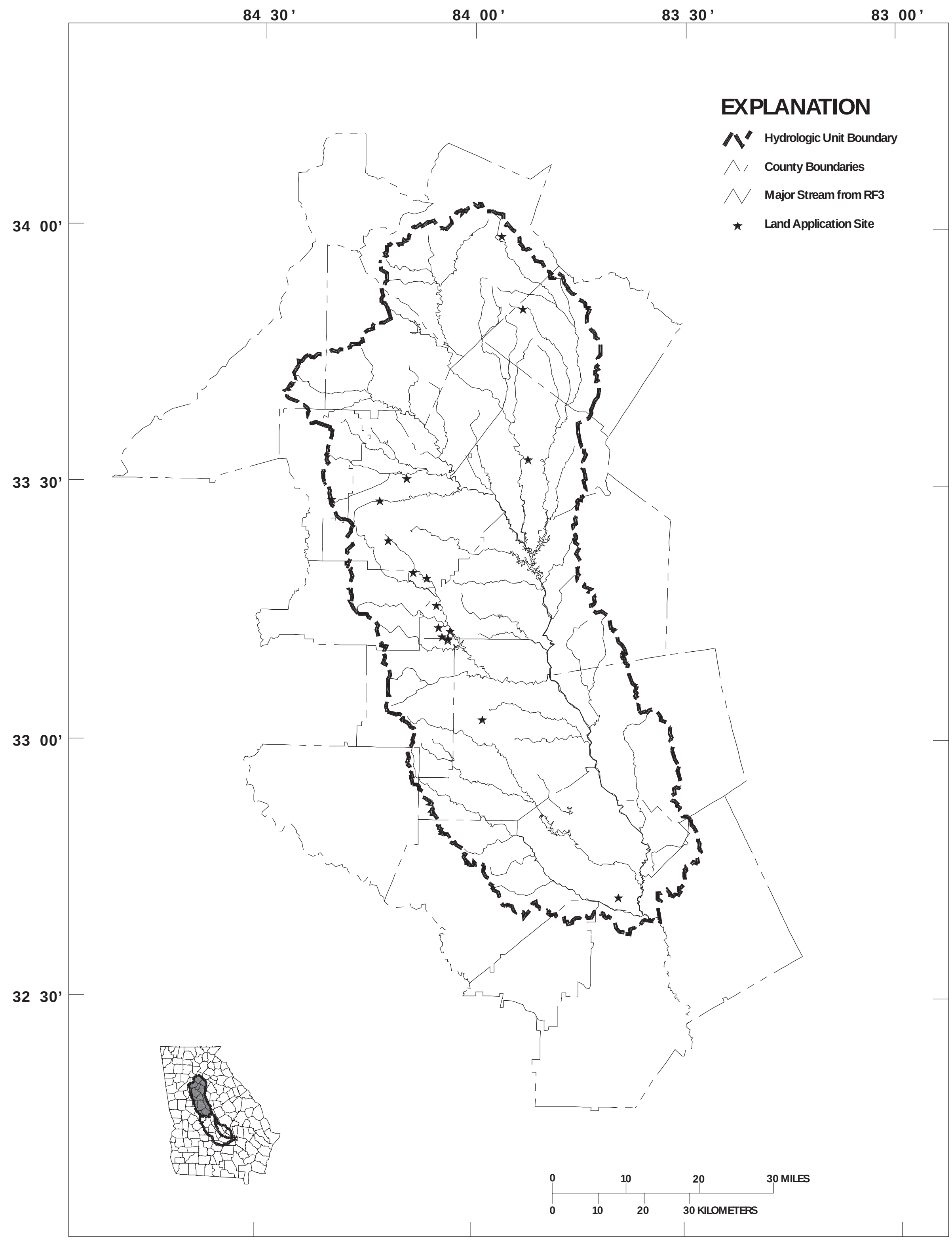

Figure 4-5. Land Application Systems, Ocmulgee River Basin, HUC 03070103

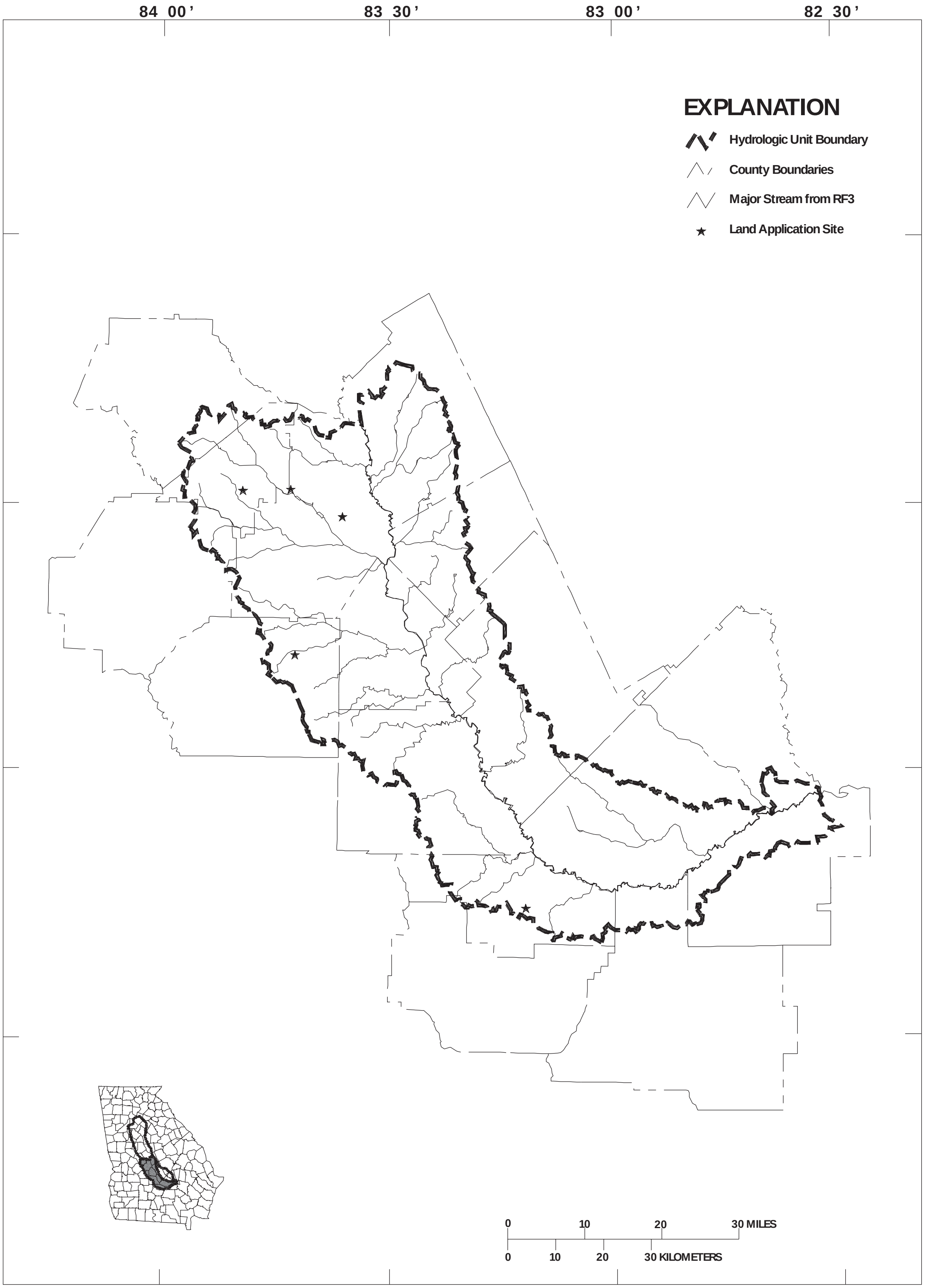

Figure 4-6. Land Application Systems, Ocmulgee River Basin, HUC 03070104

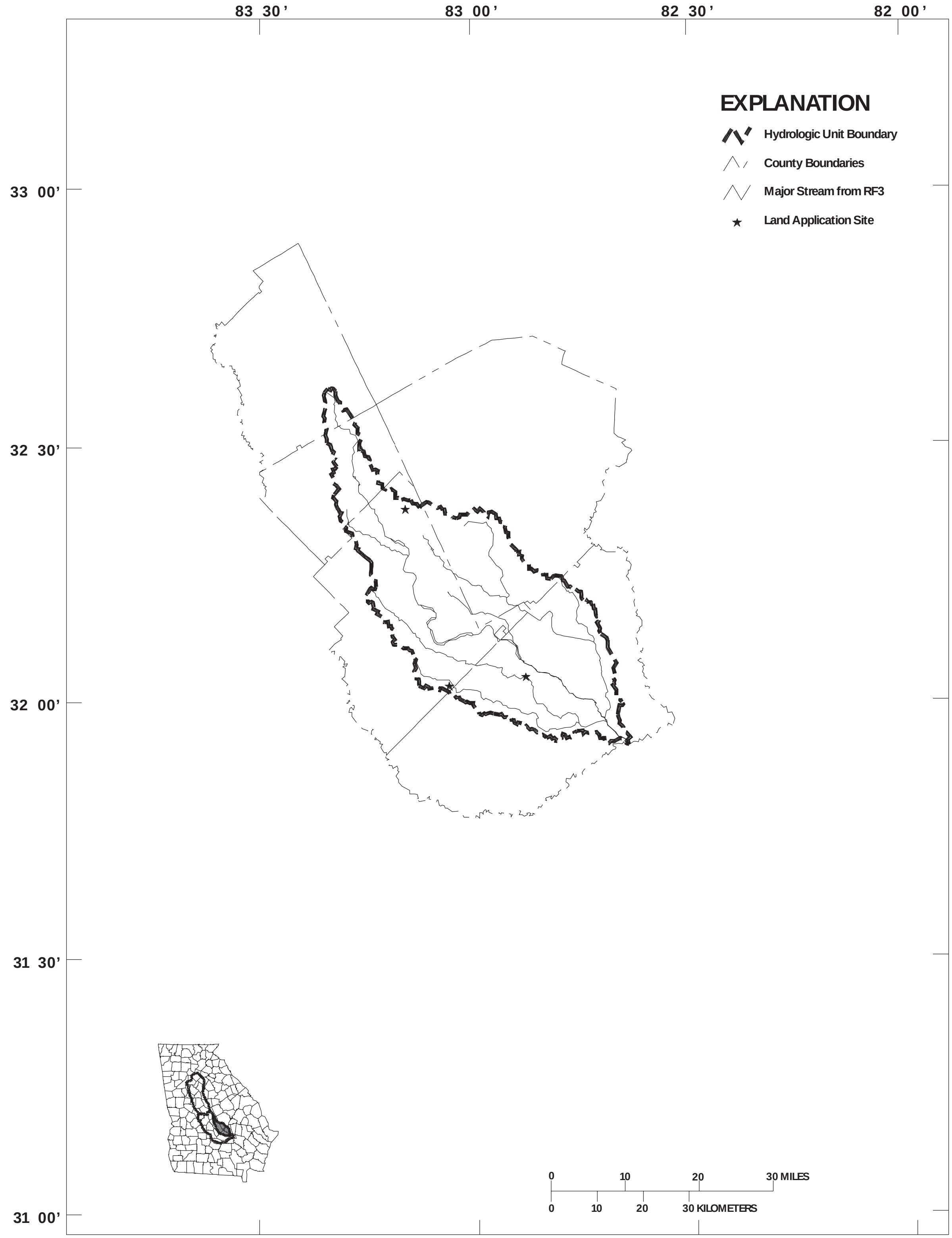

Figure 4-7. Land Application Systems, Ocmulgee River Basin, HUC 03070105

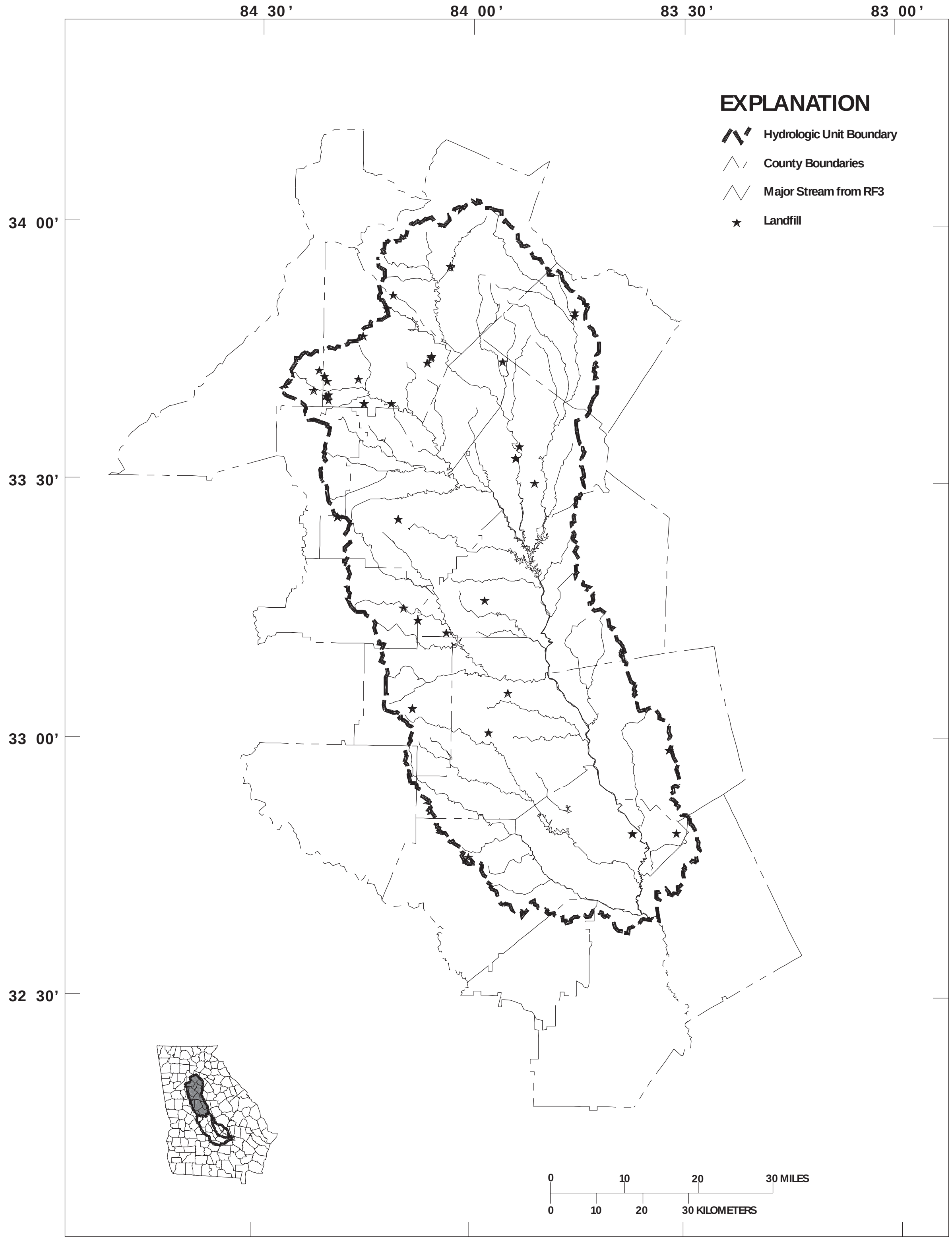

Figure 4-8. Landfills, Ocmulgee River Basin, HUC 03070103

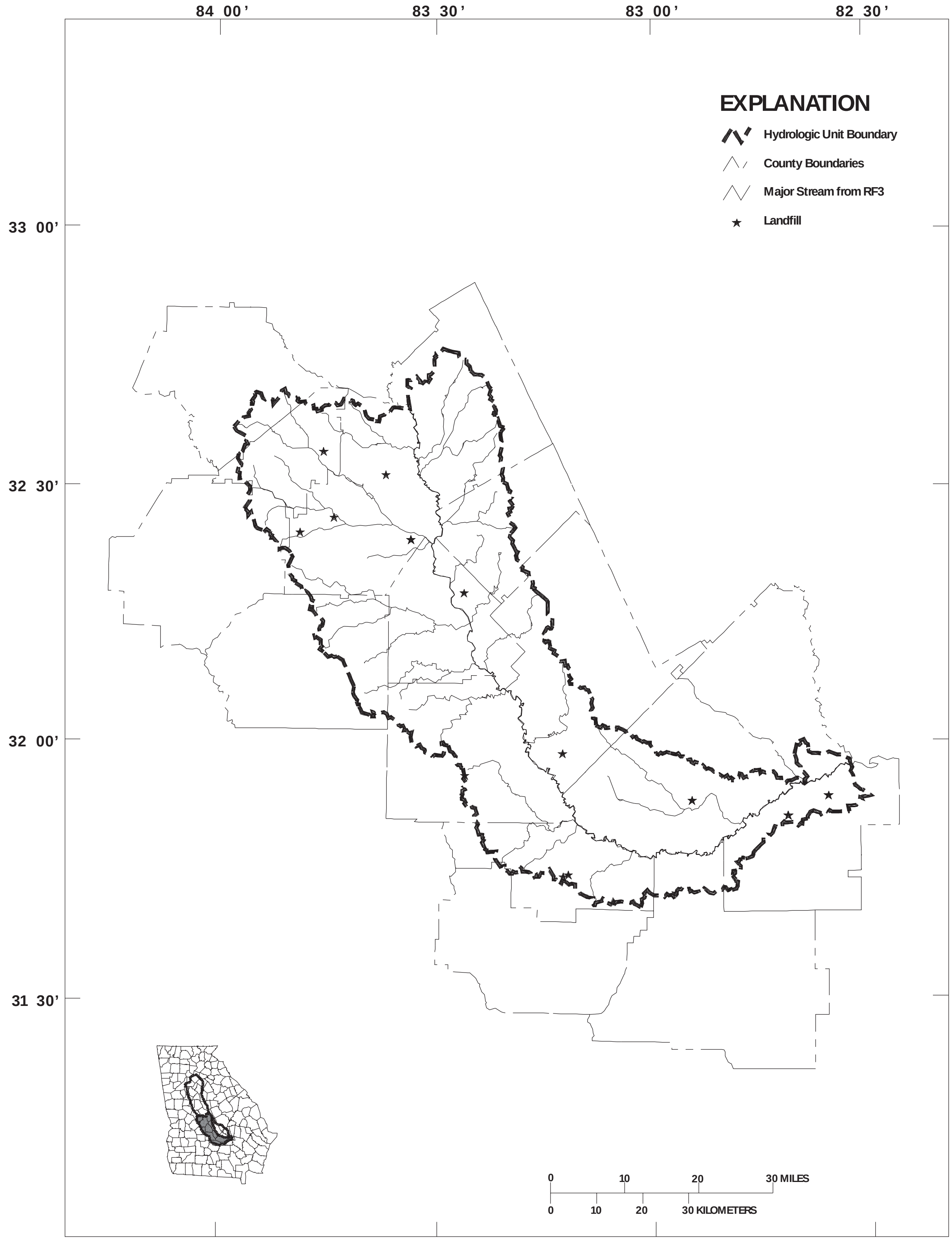

Figure 4-9. Landfills, Ocmulgee River Basin, HUC 03070104

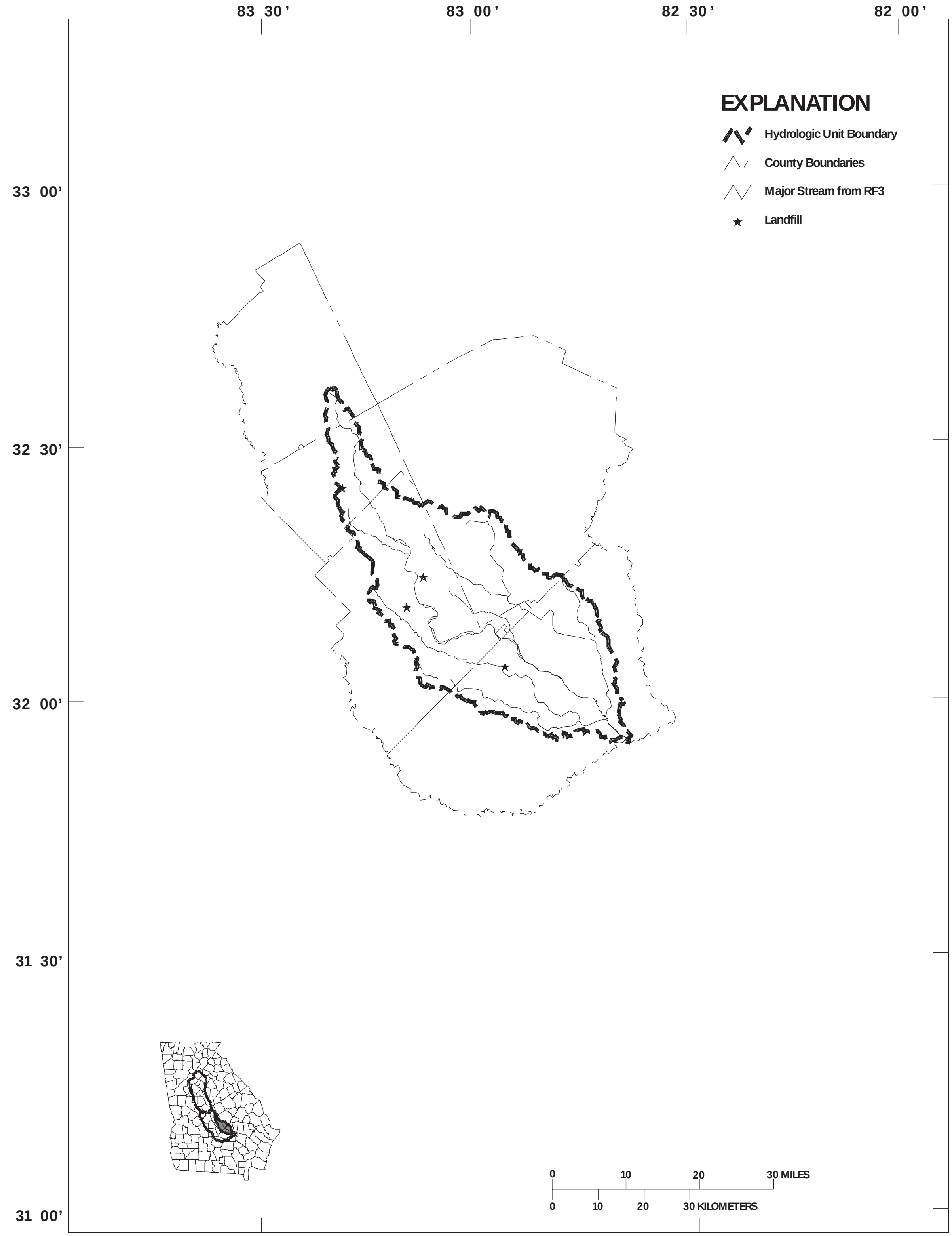

Figure 4-10. Landfills, Ocmulgee River Basin, HUC 03070105

4.1.2 Nonpoint Sources

The pollution impact on Georgia's streams has radically shifted over the last two decades. Steams are no longer dominated by untreated or partially treated sewage discharges, which had resulted in little or no oxygen and little or no aquatic life. The sewage is now treated, oxygen levels have recovered, and healthy fisheries have followed. Industrial discharges have also been placed under strict regulation. However, other sources of pollution are still affecting Georgia's streams. These sources are referred to as *nonpoint sources*. Nonpoint sources are diffuse in nature. Nonpoint source pollution can generally be defined as the pollution caused by rainfall or snowmelt moving over and through the ground. As water moves over and through the soil, it picks up and carries away natural pollutants and pollutants resulting from human activities, finally depositing them in lakes, rivers, wetlands, coastal waters, or groundwater. Habitat alteration (e.g., removal of riparian vegetation) and hydrological modification (e.g., channelization, bridge construction) can also cause adverse effects on the biological integrity of surface waters and are also treated as nonpoint sources of pollution.

Nonpoint pollutant loading comprises a wide variety of sources not subject to point source control through NPDES permits. The most significant nonpoint sources are those associated with precipitation, washoff, and erosion, which can move pollutants from the land surface to water bodies. Both rural and urban land uses can contribute significant amounts of nonpoint pollution. A review of the 2000-2001 (EPD, 2002) water quality assessment results for the Ocmulgee basin indicates that urban runoff and rural nonpoint sources contribute significantly to lack of full support for designated uses. The major categories of stressors for nonpoint sources are discussed below.

Nonpoint Sources from Agriculture

Agricultural operations can contribute stressors to water bodies in a variety of ways. Tillage and other soil-disturbing activities can promote erosion and loading of sediment to water bodies unless controlled by management practices. Nutrients contained in fertilizers, animal wastes, or natural soils may be transported from agricultural land to streams in either sediment-attached or dissolved forms. Loading of pesticides and pathogens is also of concern for various agricultural operations.

Sediment and Nutrients

Sediment is the most common pollutant resulting from agricultural operations. It consists mainly of mineral fragments resulting from the erosion of soils, but is can also include crop debris and animal wastes. Excess sediment loads can damage aquatic habitat by smothering and shading food organisms, alter natural substrate, and destroy spawning areas. Runoff with elevated sediment concentrations can also scour aquatic habitat, causing significant impacts on the biological community. Excess sediment can also increase water treatment costs, interfere with recreational uses of water bodies, create navigation problems, and increase flooding damage. In addition, a high percentage of nutrients lost from agricultural lands, particularly phosphorus, are transported attached to sediment. Many organic chemicals used as pesticides or herbicides are also transported predominantly attached to sediment.

Agriculture can be a significant source of nutrients, which can lead to excess or nuisance growth of aquatic plants and depletion of dissolved oxygen. The nutrients of most concern from agricultural land uses are nitrogen (N) and phosphorus (P), which may come from commercial fertilizer or land application of animal wastes. Both nutrients assume a variety of chemical forms, including soluble ionic forms (nitrate and phosphate) and less-soluble organic forms. Less soluble forms tend to travel with sediment, whereas more soluble forms move with water. Nitrate-nitrogen is very weakly adsorbed by soil and sediment and is therefore transported entirely in water. Because of the mobility of nitrate-nitrogen, the major route of nitrate loss is to streams by interflow or groundwater in deep seepage.

Phosphorus transport is a complex process that involves different components of phosphorus. Soil and sediment contain a pool of adsorbed phosphorus, which tends to be in equilibrium with the phosphorus in solution (phosphate) as water flows over the soil surface. The concentrations established in solution are determined by soil properties and fertility status. Adsorbed phosphorus attached to soil particles suspended in runoff also equilibrates with phosphorus in solution.

In 1993, the Soil Conservation Service (SCS, now NRCS) completed a study to identify hydrologic units in Georgia with a high potential for nonpoint source pollution problems resulting from agricultural land uses (SCS, 1993). This study concluded that there is not a major statewide agricultural pollution problem in Georgia. However, the assessment shows that some watersheds have sufficient agricultural loading to potentially impair their designated uses, based on estimates of transported sediments, nutrients, and animal wastes from agricultural lands (Table 4-5).

Table 4-5. Estimated Loads from Agricultural Lands by County (SCS, 1993)

County	Percent of Area in Basin	Sediment (tons)	Sediment (ppm)	Nitrogen (tons)	Nitrogen (ppm)	Phosphorus (tons)	Phosphorus (ppm)
Ben Hill	65%	38,230	36.0	107	0.11	41	0.043
Bibb	100%	5,204	27.1	16	0.09	6	0.035
Bleckley	83%	45,873	28.0	147	0.12	51	0.041
Butts	100%	7,365	13.0	26	0.05	11	0.023
Clayton	45%	2,580	14.5	9	0.05	4	0.020
Coffee	9%	76,637	24.3	419	0.16	122	0.048
Crawford	45%	14,480	33.8	57	0.15	20	0.053
DeKalb	70%	199	6.6	2	0.07	1	0.022
Dodge	99%	44,284	17.6	133	0.08	50	0.031
Dooly	29%	154,242	47.4	420	0.15	158	0.058
Fulton	6%	12,513	28.6	33	0.07	13	0.029
Gwinnett	61%	2,761	5.9	75	0.16	18	0.038
Henry	94%	44,085	35.1	131	0.11	52	0.044
Houston	98%	111,912	57.2	330	0.18	120	0.665
Jasper	38%	13,739	12.9	99	0.10	39	0.038
Jeff Davis	19%	16,706	7.4	112	0.06	30	0.016
Jones	47%	31,043	43.5	109	0.16	39	0.056
Lamar	72%	32,016	24.7	116	0.09	42	0.034
Laurens	18%	100,069	26.8	296	0.12	108	0.044
Macon	8%	88,717	65.2	200	0.09	44	0.020
Monroe	98%	44,702	35.0	150	0.12	55	0.044
Newton	88%	51,916	44.0	153	0.14	60	0.053
Peach	94%	43,696	34.9	125	0.11	46	0.041
Pulaski	100%	69,158	30.9	180	0.10	70	0.039
Rockdale	100%	10,645	36.3	41	0.14	14	0.048
Spalding	44%	24,366	42.0	74	0.13	28	0.050
Telfair	100%	71,081	40.1	276	0.19	87	0.059
Twiggs	67%	17,509	29.4	47	0.11	18	0.043
Upson	2%	12,767	11.4	75	0.07	27	0.025
Walton	51%	49,674	31.9	198	0.15	69	0.053
Wheeler	58%	40,088	31.7	112	0.13	43	0.051
Wilcox	70%	104,735	46.5	293	0.16	110	0.058

Note: Mass estimates are based on whole county. Concentration estimates are average event runoff concentration from agricultural lands.

In July and August 1996, USEPA conducted biological assessments on Georgia watersheds that had sufficient agricultural loading to potentially impair designated stream use to determine which of those waters should be added to Georgia's Section 303(d) list of streams with water quality limited segments. Those waters identified by USEPA as potentially impaired by agricultural nonpoint source loading and added to the 303(d) list in December 1996 are shown in Table 4-6. USEPA finalized total maximum daily loads (TMDLs) for these waters in 2002.

Table 4-6. Waters Identified as Potentially Impacted by Agricultural Nonpoint Source Loading and Added to the Georgia 303[d] List

Water Body	County	Pollutant[s] of Concern
Little Ocmulgee River	Bleckley and Dodge	Biota, Habitat
Big Creek	Houston and Pulaski	Biota, Habitat
Tobesofkee Creek	Monroe, Bibb, and Lamar	Biota, Habitat

Animal Waste

In addition to contributing to nutrient loads, animal waste may contribute high loads of oxygen-demanding chemicals, and bacterial and microbial pathogens. The waste may reach surface waters through direct runoff as solids or in their soluble form. Soluble forms may reach groundwater through runoff, seepage, or percolation and reach surface waters as return flow. As the organic materials decompose, they place an oxygen demand on the receiving waters, which may adversely affect fisheries and cause other problems with taste, odor, and color. When waters are contaminated by waste from mammals, the possible presence of pathogens that affect human health, is of particular concern. In addition to being a source of bacteria, cattle waste might be an important source of the infectious oocysts of the protozoan parasite *Cryptosporidium parvum*.

Pesticides

Pesticides applied in agricultural production can be insoluble or soluble and include herbicides, insecticides, miticides, and fungicides. They are primarily transported directly through surface runoff, either in dissolved forms or attached to sediment particles. Some pesticides can cause acute and chronic toxicity problems in the water or throughout the entire food chain. Others are suspected human carcinogens, although the use of such pesticides has generally been discouraged in recent years.

The major agricultural pesticide/herbicides use within the basin include 2,4-d, Prowl, Blazer/Basagran/Trifluralin/Treflan/Trilin, Aatrex/Atizine, Gramoxone, Classic, Lexone/Sencor, and Lasso (alachlor) (compiled from the Georgia Herbicide Use Survey summary (Monks and Brown, 1991)). Since 1990, the use of alachlor in Georgia has decreased dramatically since peanut wholesalers no longer buy peanuts with alachlor.

Nonherbicide pesticide use is difficult to estimate. According to Stell et al. (1995), pesticides other than herbicides are currently used only when necessary to control some type of infestation (nematodes, fungi, and insects). Other common nonherbicide pesticides include chlorothalonil, aldicarb, chlorpyifos, methomyl, thiodicarb, carbaryl, acephate, fonofos, methyl parathion, terbufos, disulfoton, phorate, triphenyltin hydroxide (TPTH), and synthetic pyrethroids/pyrethrins. Application periods of principal agricultural pesticides span the calendar year in the basin. However, agricultural pesticides are applied most intensively and on a broader rang of crops from March 1 to September 30 in any given year.

It should be noted that past uses of persistent agricultural pesticides that are now banned might continue to affect water quality within the basin, particularly through residual concentrations present in bottom sediments. A survey of pesticide concentration data by Stell et al. (1995) found that two groups of compounds had concentrations at or above minimum reporting levels in 56 percent of the water and sediment analyses. The first group included DDT and metabolites, and the second group included chlordane and related compounds (heptachlor, heptachlor epoxide), while dieldrin was also frequently detected. The USEPA now bans all of these pesticides for use in the United States, but they might persist in the environment for long periods of time.

Nonpoint Sources from Urban, Industrial, and Residential Lands

Water quality in urban waterbodies is affected by both point source discharges and diverse land use activities in the drainage basin (i.e., nonpoint sources). One of the most important sources of environmental stressors in the Ocmulgee River basin, particularly in the developed and rapidly growing areas, is diffuse runoff from urban, industrial, and residential land uses (jointly referred to as “urban runoff”). Nonpoint source contamination can impair streams that drain extensive commercial and industrial areas due to inputs of stormwater runoff, unauthorized discharges, and accidental spills. Wet weather urban runoff can carry high concentrations of many of the same pollutants found in point source discharges, such as oxygen-demanding waste, suspended solids, synthetic organic chemicals, oil and grease, nutrients, lead and other metals, and bacteria. The major difference is that urban runoff occurs only intermittently in response to precipitation events.

The characteristics of nonpoint urban sources of pollution are generally similar to those of NPDES permitted stormwater discharges (these are discussed in the previous section). Nonpoint urban sources of pollution include drainage from areas with impervious surfaces, but also includes less highly developed areas with greater amounts of pervious surfaces such as lawns, gardens, and septic tanks, all of which may be sources of nutrient loading.

There is little site-specific data available to quantify loading in nonpoint urban runoff in the Ocmulgee River basin, although estimates of loading rates by land use types have been widely applied in other areas.

Pesticides and Herbicides from Urban and Residential Lands

Urban and suburban land uses are also a potential source of pesticides and herbicides through application to lawns and turf, roadsides, and gardens and beds. Stell et al. (1995) provide a summary of usage in the Atlanta Metropolitan Statistic Area (MSA). The herbicides most commonly used by the lawn-care industry are combinations of dicamba, 2,4-D, mecoprop (MCPP), 2,4-DP, and MCPA, or other phenoxy-acid herbicides, while most commercially available weed control products contain one or more of the following compounds: glyphosphate, methyl sulfometuron, benefin (benfluralin), bensulide, acifluorfen, 2,4-D, 2,4-DP, or dicamba. Atrazine was also available for purchase until it was restricted by the State of Georgia on January 1, 1993. The main herbicides used by local and state governments are glyphosphate, methyl sulfometuron, MSMA, 2,4-D, 2,4-DP, dicamba, and chlorsulforon. Herbicides are used for pre-emergent control of crabgrass in February and October, and in the summer for post-emergent control. Data from the 1991 Georgia Pest Control Handbook (Delaplane, 1991) and a survey of CES and SCS personnel conducted by Stell et al. Indicate that several insecticides could be considered ubiquitous in urban/suburban use, including chlorpyrifos, diazinon, malathion, acephate, carbaryl, lindane, and dimethoate. Chlorothalonil, a fungicide, is also widely used in urban and suburban areas.

Other Urban/Residential Sources

Urban and residential stormwater also potentially includes pollutant loads from a number of other terrestrial sources:

Septic Systems. Poorly sited and improperly operating septic systems can contribute to the discharge of pathogens and oxygen-demanding pollutants to receiving streams. This problem is addressed through septic system inspections by the appropriate county health department, extension of sanitary sewer service, and local regulations governing minimum lot sizes and required pump-out schedules for septic systems.

Leaking Underground Storage Tanks. The identification and remediation of leaking underground storage tanks (LUSTs) is the responsibility of the EPD Land Protection Branch. Petroleum hydrocarbons and lead are typically the pollutants associated with LUSTs.

Nonpoint Sources from Forestry

According to the US Forest Service's Forest Statistics for Georgia 1997 report (Thompson, 1997), there are approximately 1,370,600 acres subject to silvicultural activities on an annual basis in Georgia (Table 4-7). This does not include natural disturbances such as weather, insects, animal, wildfire, or disease.

Table 4-7. Silvicultural Activities in Georgia

Treatment Type	Total Acres	Public	Forest Industry	Private
Final Harvest	445,600	8,000	133,200	304,400
Partial Harvest	97,200	3,500	9,200	84,500
Thinning	87,600	2,600	33,600	51,400
Stand Improvement	22,600	4,400	4,600	13,600
Site Preparation	230,800	2,600	115,600	112,700
Artificial Regeneration	308,300	3,100	116,400	188,800
Other	178,500	7,000	18,300	153,200
Total	*1,370,600*	*31,200*	*430,900*	*908,600*

Silvicultural operations may serve as sources of stressors, particularly excess sediment loads to streams, when Best Management Practices (BMPs) are not followed. From a water quality standpoint, woods roads pose the greatest potential threat of any of the typical forest practices. It has been documented that 90 percent of the sediment that entered streams from a forestry operation was directly related to either poorly located or poorly constructed roads and stream crossings. The potential impact to water quality from erosion and sedimentation is increased if BMPs are not adhered to.

Silviculture is also a potential source of pesticides/herbicides. According to Stell et al. (1995), pesticides are mainly applied during site preparation after clear-cutting and during the first few years of new forest growth. Site preparation occurs on a 25-year cycle on most pine plantation land, so the area of commercial forest with pesticide application in a given year is relatively small. The herbicides glyphosate (Accord), sulfometuron methyl (Oust), hexazinone (Velpar), imazapyr (Arsenal), and metsulfuron methyl (Escort) account for 95 percent of the herbicides used for site preparation to control grasses, weeds, and broadleaves in pine stands. Dicamba, 2,4-D, 2,4,-DP (Banvel), triclopyr (Garlon), and picloram (Tordon) are minor use chemicals used to control hard to kill hardwoods and kudzu. The use of triclopyr and picloram has decreased since the early 1970s.

Most herbicides are not mobile in the soil and are targeted to plants, not animals. Applications made following the label and in conjunction with BMPs should pose little threat to water quality.

Chemical control of insects and diseases is not widely practiced except in forest tree nurseries, which is a very minor land use. Insects in pine stands are controlled by chlorpyrifos, diazinon, malathion, acephate, carbaryl, lindane, and dimethoate. Diseases are controlled using chlorothalonil, dichloropropene, and mancozeb. There is one commercial forest seed orchard located in Pulaski County, and it is operated by the GFC. There are three private nurseries that grow containerized seedlings. They are located in DeKalb, Dodge and Telfair counties.

According to the Water Quality in Georgia 2002 Report, no streams were identified in the basin as impacted due to commercial forestry activities. However, 54 stream segments are listed as biota impaired mainly due to sedimentation from nonpoint source activities.

Atmospheric Deposition

Atmospheric deposition can be a significant source of nitrogen and acidity in watersheds. Nutrients from atmospheric deposition, primarily nitrogen, are distributed throughout the entire basin in precipitation. The primary source of nitrogen in atmospheric deposition is nitrogen oxide emissions from combustion of fossil fuels. The rate of atmospheric deposition is a function of topography, nutrient sources, and spatial and temporal variations in climatic conditions.

Atmospheric deposition can also be a source of certain mobile toxic pollutants, including mercury, PCBs, and other organic chemicals.

4.1.3 Flow and Temperature Modification

Many species of aquatic life are adapted to specific flow and temperature regimes. In addition, both flow and temperature affect the dissolved oxygen balance in water, and changes in flow regime can have important impacts on physical habitat.

Thus, flow and temperature modifications can be important environmental stressors. They also interact with one another to affect the oxygen balance: flow energy helps control reaeration rate, while water temperature controls the solubility of dissolved oxygen, and higher water temperatures reduce oxygen solubility and thus tend to reduce dissolved oxygen concentrations. Further, increased water temperature raises the rate of metabolic activity in natural waters, which in turn may increase oxygen consumption by aquatic species.

4.1.4 Physical Habitat Alteration

Many forms of aquatic life are sensitive to physical habitat disturbances. Probably the major disturbing factor is erosion and loading of excess sediment, which changes the nature of the stream substrate. Thus, any land use practices that cause excess sediment input can have significant impacts.

Physical habitat disturbance is also evident in many urban streams. Increased impervious cover in urban areas can result in high flow peaks, which increase bank erosion. In addition, construction and other land-disturbing activities in these areas often provide an excess sediment load, resulting in a smothering of the natural substrate and physical form of streams with banks of sand and silt.

4.2 Summary of Stressors Affecting Water Quality

Section 4.1 described the major sources of loads of pollutants (and other types of stressors) to the Ocmulgee basin. What happens in a river is often the result of the combined impact of many different types of loading, including point and nonpoint sources. For instance, excess concentrations of nutrients may result from the combined loads of wastewater treatment plant discharges, runoff from agriculture, runoff from residential lots, and other sources. Accordingly, Section 4.2 brings together the information contained in Section 4.1 to focus on individual stressor types, as derived from all sources.

4.2.1 Nutrients

All plants require certain nutrients for growth, including the algae and rooted plants found in lakes, rivers, and streams. Nutrients required in the greatest amounts include nitrogen and phosphorus. Some loading of these nutrients is needed to support normal growth of aquatic plants, an important part of the food chain. Too much loading of nutrients can, however, result in an overabundance of algal growth with a variety of undesirable impacts. The condition of excessive nutrient-induced plant production is known as eutrophication, and waters affected by this condition are said to be eutrophic. Eutrophic waters often experience dense blooms of algae, which can lead to unaesthetic scums and odors and interfere with recreation. In addition, overnight respiration of living algae, and decay of dead algae and other plant material, can deplete oxygen from the water, stressing or killing fish. Eutrophication of lakes typically results in a shift in fish populations to less desirable, pollution-tolerant species. Finally, eutrophication may result in blooms of certain species of blue-green algae that have the capability of producing toxins.

For freshwater aquatic systems, the nutrient in the shortest supply relative to plant demands is usually phosphorus. Phosphorus is then said to be the limiting nutrient because the concentration of phosphorus limits potential plant growth. Control of nutrient loading to reduce eutrophication thus focuses on phosphorus control.

Point and nonpoint sources to the Ocmulgee also discharge quantities of nitrogen, but nitrogen is usually present in excess of amounts required to match the available phosphorus. Nitrogen (unlike phosphorus) is also readily available in the atmosphere and ground water, so it is not usually the target of management to control eutrophication in freshwater. The bulk of the nitrogen in fresh-water systems is found in three ionic forms –ammonium (NH_4^+), nitrite (NO_2^-), or nitrate (NO_3^-). Nitrite and nitrate are more readily taken up by most algae, but ammonia is of particular concern because it can be toxic to fish and other aquatic life. Accordingly, wastewater treatment plant upgrades have focused on reducing the toxic ammonia component of nitrogen discharges, with a corresponding increase in the nitrate fraction.

Sources of Nutrient Loading

The major sources of nutrient loading in the Ocmulgee basin are wastewater treatment facilities, urban runoff and stormwater, and agricultural runoff. Concentrations found in the streams and rivers of the Ocmulgee basin represent a combination of point and nonpoint source contributions.

Point source loads can be quantified from permit and effluent monitoring data, but nonpoint loads are difficult to quantify. Rough estimates of average nutrient loading rates from agriculture are available; however, nonpoint loads from urban/residential sources in the basin have not yet been quantified. The long-term trends in phosphorus within the Ocmulgee River basin can be obtained by examining results from EPD long-term trend monitoring stations. Trends in instream total phosphorus concentrations at two sites in the Ocmulgee River are shown in Figures 4-11 and 4-12. In general, phosphorus concentrations have declined over time as a result of improvements in wastewater treatment technology.

4.2.2 Oxygen Depletion

Oxygen is required to support aquatic life, and Georgia water quality standards specify minimum and daily average dissolved oxygen concentration standards for all waters. Violations of water quality standards for dissolved oxygen were the third most commonly listed cause of nonsupport of designated uses in the Georgia 2002 303(d) list based primarily on water quality data collected as part of the focused monitoring in the Altamaha River basin in 1999. The data identified dissolved oxygen impairments for 10 stream segments and indicated that these impairments occurred during, and were limited to summer months, low flow, and high temperature conditions. Stream flows during the periods of impairment were at or below 7Q10 (the minimum 7-day average flow that occurs once in 10 years on the average), which is consistent with the 3-year drought experienced in Georgia from 1998 to 2000. All of the impairments occurred in small, headwater streams where the drainage areas are relatively small and dry weather flows are low or zero. TMDLs finalized for each stream segment in 2002 concluded that the main influence on dissolved oxygen was natural conditions with point sources affecting a small number of the segments. Trends in instream dissolved oxygen concentrations at two sites in the Ocmulgee River basin are shown in Figures 4-13 and 4-14. All waters in the Ocmulgee basin have a state water quality standard of 4.0 mg/L. As shown in Figures 4-13 and 4-14, dissolved oxygen concentrations are usually above this standard.

4.2.3 Metals

A violation of water quality standards for metals attributed to nonpoint sources was detected in one segment of the Ocmulgee River during the 1999 sampling. Point sources of metals in the Ocmulgee basin (wastewater treatment plants and certain industrial discharges) have been brought into compliance with permit limits, leaving nonpoint sources that are more difficult to control as the primary cause of impairment.

4.2.4 Fecal Coliform Bacteria

Violations of the standard for fecal coliform bacteria were the most commonly listed cause of nonsupport of designated uses in the Georgia 2002 303(d) list. Fecal coliform bacteria are monitored as an indicator of fecal contamination and the possible presence of human bacterial and protozoan pathogens in water. Fecal coliform bacteria may arise from many of the different point and nonpoint sources discussed in Section 4.1.

Human waste is of greatest concern as a potential source of bacteria and other pathogens. One primary function of wastewater treatment plants is to reduce this risk through disinfection.

Trends in instream fecal coliform concentrations at two sites in the Ocmulgee River basin are shown in Figures 4-15 and 4-16.

As point sources have been brought under control, nonpoint sources have become increasingly important as potential sources of fecal coliform bacteria. Nonpoint sources may include:

- Agricultural nonpoint sources, including concentrated animal operations and spreading and/or disposal of animal wastes.
- Runoff from urban areas transporting surface dirt and litter, which may include both human and animal fecal matter, as well as a fecal component derived from sanitary sewer overflows.
- Urban and rural input from failed or ponding septic systems.
- Wildlife.

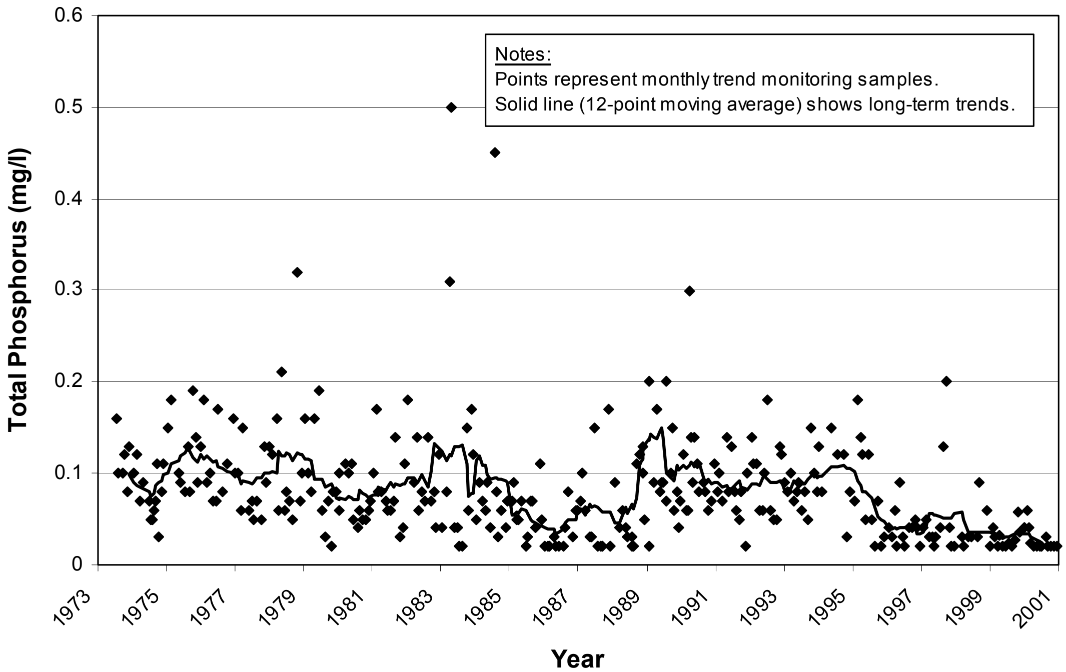

Figure 4-11. Total Phosphorus Concentrations, Ocmulgee River at the Water Intake for the City of Macon, GA

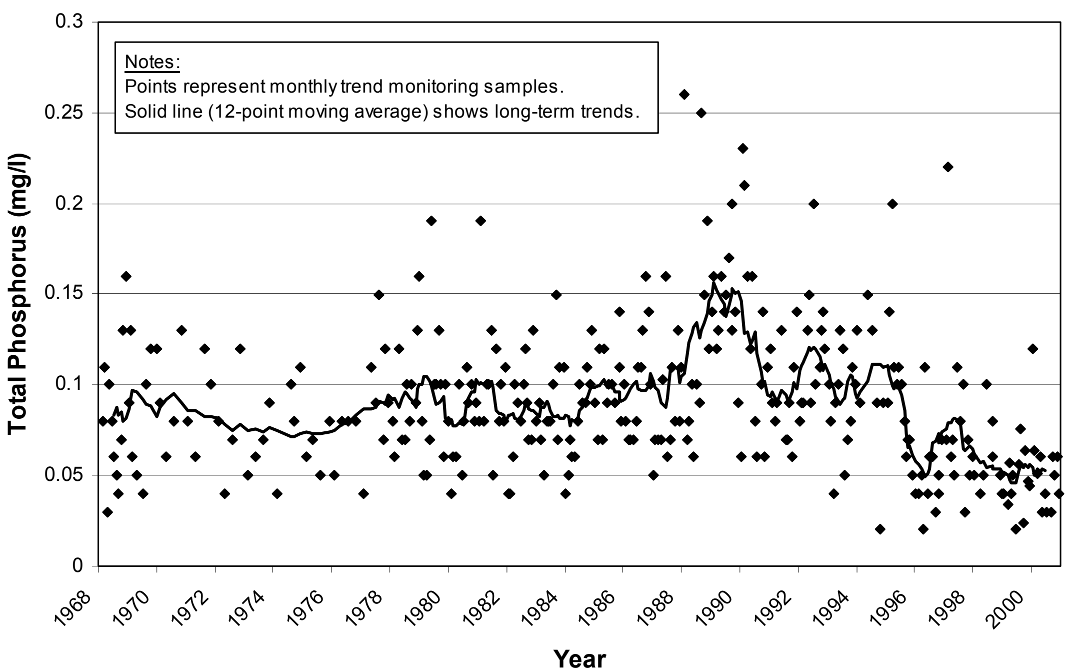

Figure 4-12. Total Phosphorus Concentrations, Ocmulgee River at U.S. Highway 341 at Lumber City, GA

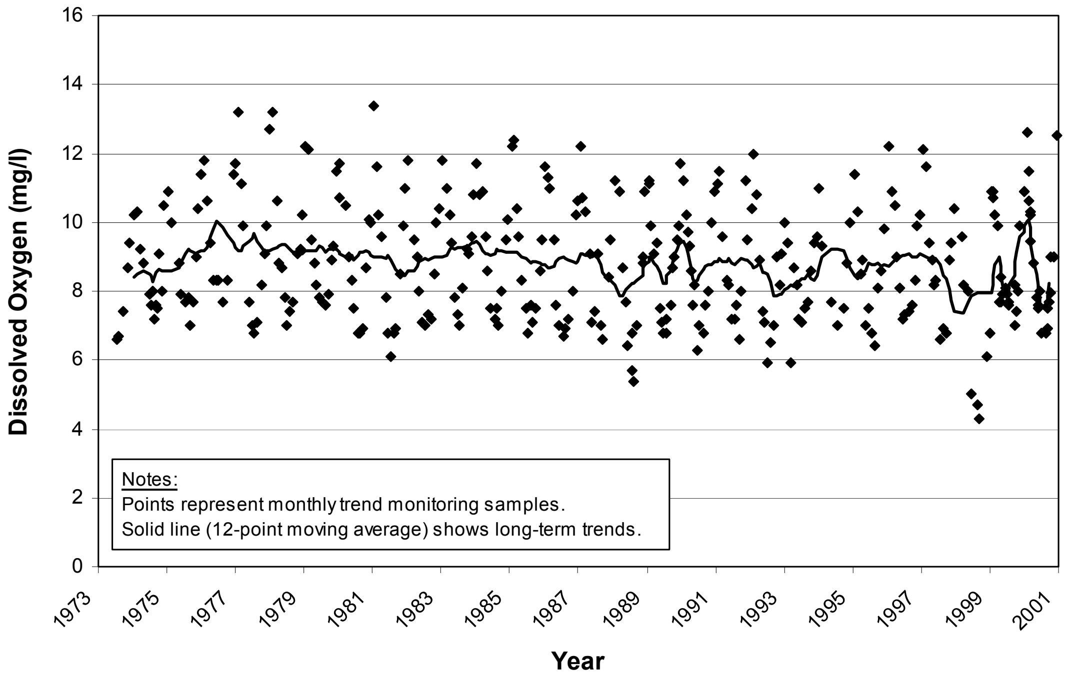

Figure 4-13. Dissolved Oxygen Concentrations, Ocmulgee River at the Water Intake for the City of Macon, GA

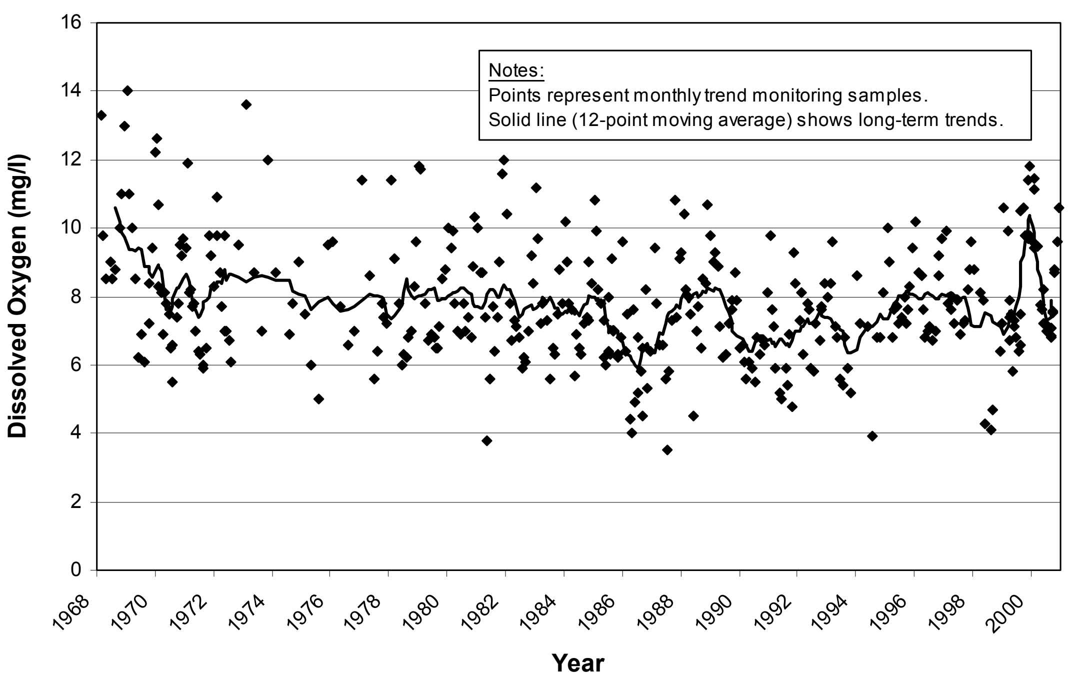

Figure 4-14. Dissolved Oxygen Concentrations, Ocmulgee River at U.S. Highway 341 at Lumber City, GA

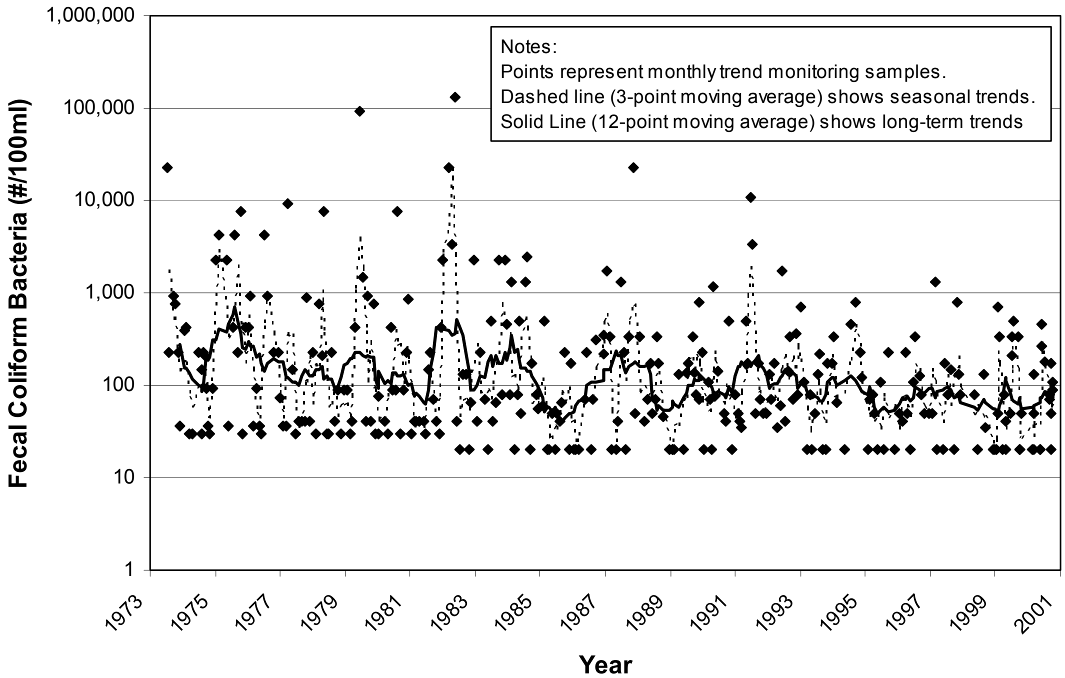

Figure 4-15. Fecal Coliform Bacteria Concentrations, Ocmulgee River at the Water Intake for the City of Macon, GA

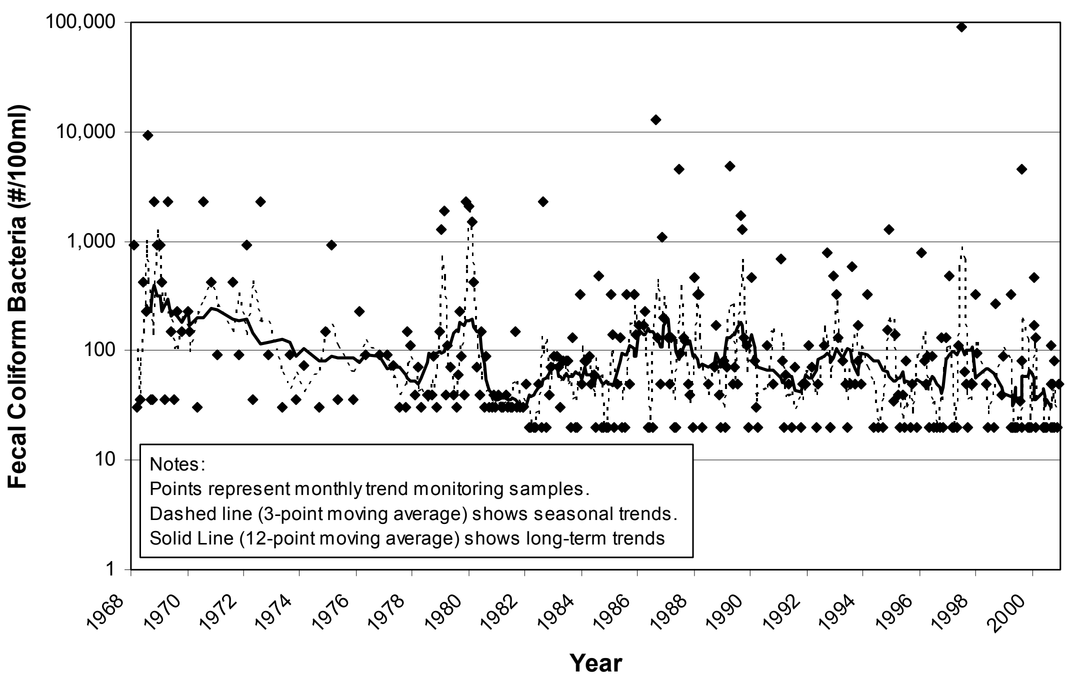

Figure 4-16. Fecal Coliform Bacteria Concentrations, Ocmulgee River at U.S. Highway 341 at Lumber City, GA

4.2.5 Synthetic Organic Chemicals

Synthetic organic chemicals (SOCs) include pesticides, herbicides, and other man-made toxic chemicals. SOCs may be discharged to waterbodies in a variety of ways, including:

- Industrial point source discharges.
- Wastewater treatment plant point source discharges, which often include industrial effluent as well as SOCs from household disposal of products such as cleaning agents and insecticides.
- Nonpoint runoff from agricultural and silvicultural land with pesticide and herbicide applications.
- Nonpoint runoff from urban areas, which may load a variety of SOCs such as horticultural chemicals and termiticides.
- Illegal disposal and dumping of wastes.

SOCs were not detected in the surface waters of the Ocmulgee River basin in problem concentrations. It should be noted, however, that most monitoring has been targeted to waters located below point sources where potential problems were suspected. Agricultural sources were potentially important in the past, particularly from cotton production in the Coastal Plain, but the risk has greatly declined with a switch to less persistent pesticides. Recent research by USGS (Hippe et al., 1994; Stell et al., 1995) suggests pesticide/herbicide loading in urban runoff and stormwater may be of greater concern than agricultural loading, particularly in streams of the metropolitan Atlanta area.

4.2.6 Stressors from Flow Modification

Stress from flow modification is primarily associated with stormflow in smaller streams associated with development and increased impervious area.

4.2.7 Sediment

Poor or very poor fish communities due to sediment were the second-most commonly listed cause of nonsupport of designated uses in the Georgia 2002 303(d) list. Erosion and discharge of sediment can have a number of adverse impacts on water quality. First, sediment can carry attached nutrients, pesticides, and metals into streams. Second, sediment is itself a stressor. Excess sediment loads can alter habitat, destroy spawning substrate, and choke aquatic life, while high turbidity also impairs recreational and drinking water uses. Sediment loading is of concern throughout the basin, but is of greatest concern in the developing urban areas and major transportation corridors. The rural areas are of lesser concern with the exception of rural unpaved road systems and areas where cultivated cropland exceeds 20 percent of the total land cover. It should also be noted that much of the sediment may be legacy sediment from farm practices in the past.

4.2.8 Habitat Degradation and Loss

In many parts of the Ocmulgee basin, support for native aquatic life is potentially threatened by degradation of aquatic habitat. Habitat degradation is closely tied to sediment loading, and excess sediment is the main threat to habitat in rural areas with extensive land-disturbing activities, as well as in urban areas where increased flow peaks and construction can choke and alter stream bottom substrates. A second important type of habitat degradation in the Ocmulgee basin is loss of riparian tree cover, which can lead to increased water temperatures.

4.2.9 pH

pH is a relative measure of the acidity or alkalinity of a solution, and generally ranges from 0 to 14 with a pH of 7 indicating a neutral solution (for example, distilled water). Decreasing pH below 7 indicates greater acidity, while increasing pH above 7 indicates greater alkalinity. For example, vinegar has a pH of 2, while bleach has a pH of 12.5. Aquatic life can tolerate a pH in a fairly narrow range. Georgia's water quality standards state that pH must remain in a range of 6.0 to 8.5. In addition to the direct harmful effects of high or low pH to aquatic organisms, low pH is a further problem because it can increase the concentrations of dissolved metals in water, which are harmful to aquatic life.

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